

Docket No. F-8590

Scr. No. 10/524,622

REMARKS

Claim 1 remains pending in this application. Claims 1-2 are rejected. Claim 2 is cancelled herein. Claim 1 is amended herein to clarify the invention and include the limitations of claim 2.

Claims 1 and 2 have been rejected under 35 U.S.C. § 103(a) as obvious over JP 7-40015 (JP'015) in view of JP 61-256961 (JP'961).

The present invention is directed to a production method for an immersion nozzle used for continuous casting of an aluminum killed high grade molten steel, to which is applied a zirconia-graphite refractory mixture on the powder-line and a refractory mixer containing a clinker which includes CaO in a state of mineral phase on the inner-hole portion to prevent alumina buildup during casting. Being in a state of mineral phase means that the CaO particles exist independently of one another in a clinker aggregate, not as a solid solution or complicated compound. The problem resolved by the present invention is the occurrence of cracks during the burning process in a reduction atmosphere, after integrally molding the immersion nozzle.

The cracks occur on the molded nozzle because CaO as a mineral phase expands during the burning process, because of a hydration reaction of CaO with water released from a resin. The expansion of CaO as a mineral phase can be prevented by subjecting the mineral phase CaO particles to an anti-hydration

Docket No. F-8590

Ser. No. 10/524,622

treatment, which converts the CaO exposed on the outside surface of clinker particles to CaCO_3 .

The present invention resolves the occurrence of cracks during the burning process in a reduction atmosphere, which occurs after the integral molding of the immersion nozzle. JP '015 does not recognize the occurrence of any cracks on the inner hole to which CaO is applied and fails to disclose or suggest any way of prevention of expansion of CaO particles due to hydration with water generated from the binder, which is the cause of cracking during the burning or heating process of the molded nozzle of the present invention. Also, JP '961 only discloses calcia clinker consisting of CaO-MgO used as a starting material of a refractory which is applied to a lining of a steel making converter. The surface portion of the CaO is carbo-oxidized to CaCO_3 to improve the anti-hydration properties. JP '961 fails to disclose or suggest the idea of a carbo-oxidized calcia clinker as a way to eliminate cracks during the burning process of immersion nozzle manufacture, nor an immersion nozzle having a specialized construction as defined in the present claims. Thus, none of the cited references disclose a way to eliminate the cracks during the burning process.

The Office Action states that it would have been obvious to one of ordinary skill to modify the invention of JP '015 by using the anti-hydration treatment on the CaO-containing clinker particles of JP '015 as taught by JP '961 in order to have a high resistance to slaking/crumbling. However, JP '015 does not describe

Docket No. F-8590

Scr. No. 10/524,622

the problem of the cracking caused by CaO as described in the present invention and as resolved by the present invention.

The problem to be resolved by the present invention is to eliminate the occurrence of cracks during the burning process when manufacturing an immersion nozzle. JP '015 fails to disclose or suggest any problems with cracking during manufacturing. Thus, there is no reason for one of ordinary skill in the art to introduce an anti-hydration treatment to suppress the cracks, such as a carbo-oxidizing anti-hydration treatment. Moreover, JP '015 in view of JP '961 do not disclose or suggest an anti-hydration treatment to convert CaO in a mineral phase exposed on an outside surface of the clinker particle to CaCO_3 in the production of an immersion nozzle.

The Office Action states that JP '015 discloses CaO in a mineral phase. However, paragraph 0016 does not disclose the CaO being present in a mineral phase. In fact, the CaO content of the calcium zirconate is limited to 31 wt. % in order to avoid the presence of CaO in a mineral phase. Accordingly, JP '015 specifically attempts to avoid having a mineral phase of CaO and therefore teaches away from the claimed invention. In other words, JP '015 specifically excludes the inclusion of CaO in a mineral phase. Thus, JP '015 discloses that CaO is not present in a mineral phase and is, instead, present only as a CaZrO_3 compound. JP '015 specifically states that CaO in a mineral phase (CaO in a free state) is not desirable and is avoided. CaO in a mineral phase means that the CaO is in free

Docket No. F-8590

Ser. No. 10/524,622

form and is not CaO as a composite compound or a solid solution. One of ordinary skill in the art would know what is meant by CaO in mineral phase and would know that JP '015 discloses that CaO is not present in a mineral phase.

In JP '015, the CaO is in a state of being combined with zirconia. This state of CaO is not easily hydrated with water. Therefore, there is no need to treat the clinker particles of JP '015 with an anti-hydration treatment since the hydration is already difficult to occur. The Supreme Court has made clear that a claim composed of several elements "is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art" and stated the importance of identifying "a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does." *See KSR International Co. v. Teleflex Inc. et al.* 82 USPQ2d 1385, 1396 (2007). One of ordinary skill in the art would not be prompted to treat the clinker particles of JP '015 with an anti-hydration treatment since hydration is already being controlled by the use of calcium zirconate.

Accordingly, for the aforementioned reasons, claim 1 is believed patentable over the cited art.

Claim 1 has been clarified and to include the limitations of claim 2, which has been cancelled.

Applicants respectfully request a two month extension of time for responding to the Office Action. **The fee of \$460.00 for the extension is provided**

Docket No. F-8590

Ser. No. 10/524,622

for in the charge authorization presented in the PTO Form 2038, Credit Card Payment form, provided herewith.

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In light of the foregoing, the application is now believed to be in proper form for allowance of all claims and notice to that effect is earnestly solicited.

Respectfully submitted,
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